IN THE MATTER OF
KOREAN PATENT APPLICATION
UNDER SERIAL NO. 85636/2002

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THAT I AM CONVERSANT WITH BOTH THE KOREAN AND THE ENGLISH LANGUAGES : AND

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UNDER KOREAN PATENT APPLICATION

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IN THE NAME OF:
LG.. PHILIPS LCD CO., LTD

FOR:
METHOD FOR FORMING PATTERN OF LIQUID CRYSTAL DISPLAY DEVICE

IN WITNESS WHEREOF, I SET MY HAND HERETO

THIS 21TH DAY OF NOVEMBER, 2005

BY Lee

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[Translation]

ABSTRACT OF THE DISCLOSURE

[Abstract]

A method for fabricating a liquid crystal display (LCD) comprises preparing a cliché; filling resist with a certain thickness in the cliché; transferring the resist pattern filled in the cliché onto a roller; and transferring the resist pattern with the uniform thickness put on the roller onto a substrate. When resist suitable for a small pattern is used, a large pattern is divided into a size of a pattern most suitable for a print state, thereby preventing print deficiency in the large pattern.

[Representative drawing]

Figure 4a

[SPECIFICATION]

[Title of the Invention]

FABRICATION METHOD OF LIQUID CRYSTAL DISPLAY DEVICE

[Brief description of the Drawings]

Figure 1 is a diagram showing a general liquid crystal display (LCD) device;

Figures 2a through 2d are processing views illustrating conventional printing process;

Figures 3a and 3b are views showing a comparison between a normal pattern and a defective pattern;

Figures 4a through 4e are processing views illustrating a fabrication method of LCD device according to the present invention; and

Figures 5a through 5c are views showing another embodiment of the present invention.

**** Explanation for the major reference numerals ****

100, 200 : cliche

132, 232 : doctor blade

133, 233 : roller

106a~106c, 206a~206c : resist pattern

[Detailed description of the invention]

[Object of the invention]

[Field of the invention and background art]

The present invention relates to a fabrication method of a liquid crystal display

(LCD) device and, more particularly, to a fabrication method of an LCD for solving pattern inferiority that can occur in a method for depositing resist through a printing method.

A cathode ray tube (CRT) monitor has been mainly used for displaying information of TV and computer so far. The CRT has higher image quality and brightness, and therefore, the CRT has been mainly used for the display devices. However, as a screen grows larger, the size of the CRT monitor becomes so big that the monitor occupies large space. In addition, the weight of the display becomes a problem as potable devices are commonly used.

To solve the above problems, there are flat panel display devices such as liquid crystal display, plasma display panel, organic electro luminescence, light emitting diode, field emission display, etc.. Among those flat panel display devices, the liquid crystal display (LCD) device is highlighted since it is already used as a monitor of notebook PC or of desktop PC and has low power consumption.

Structures and functions of a lower substrate and an upper substrate constructing the above LCD device will be described in more detail with reference to Figure 1.

As shown therein, the LCD device comprises a lower substrate 10, an upper substrate 20 and a liquid crystal layer 15 formed therebetween.

A thin film transistor (T) and a pixel electrode 7 are formed on the lower substrate 10. The thin film transistor T comprises: a gate electrode 1 to which a scan signal is applied; a semiconductor layer 3 for transmitting a data signal corresponding to the scan signal; a gate insulating layer 2 for isolating the semiconductor layer 3 and the gate electrode 1 electrically; a source electrode 4 formed on an upper part of the semiconductor layer 2 for applying the data signal; and a drain electrode 5 applying the data signal to the pixel electrode 7. And the semiconductor layer 3 comprises an active

layer 3a formed by depositing amorphous silicon (a-Si), and an ohmic contact layer 3b n+ doped on both upper sides of the active layer 3a. A passivation layer 6 and the pixel electrode 7 are formed on the thin film transistor T, and a first alignment layer 4a formed for aligning liquid crystal molecules is formed on an upper part of the pixel electrode7. Herein, the pixel electrode 7 is made by a transparent conductor, that is, indium tin oxide (ITO) or indium zinc oxide (IZO) so that the light can be transmitted therethrough.

A black matrix 12 is formed on the upper substrate 20 for preventing the light from leaking between pixels, and color filters 11 of R, G and B colors for realizing colors actually are formed on the black matrix 12. And a flattening layer (not shown) is additionally formed on the color filter 11 for flattening the color filter and for improving adhesiveness with a common electrode 13 formed thereon, and the common electrode 13 for applying voltage to the liquid crystal layer 15 and a second alignment layer 4b for aligning the liquid crystal molecules are formed on upper part thereof. Herein, the common electrode 13 is made of the transparent conductor, that is, ITO or IZO so that the light can be transmitted therethrough.

In order to fabricate the LCD device, several steps of thin film deposition process and photolithography process should be performed. Especially, in order to fabricate the thin film transistor T, color filters 11 and the black matrix 12, photoresist pattern is formed by applying photoresist, exposure and strip processes using a mask, and after that, an etching process is performed using the photoresist pattern as a mask. Above photoresist forming process has complex fabrication processes and is not suitable for a display device of larger area.

Therefore, a printing method by which patterned photoresist can be formed simply without exposure process is suggested recently.

Hereinafter, the printing method will be described in detail as follows with

reference to accompanying Figures.

Figures 2a through 2d are processing cross-sectional views illustrating the printing method.

First, as shown in Figure 2a, the resist is applied on a cliché 200 on which a recess 23 is formed, and after that, the cliché 200 on which the resist is applied is flattened using a doctor blade 32 to remove remained resist except the resist 31 on the patterned area.

The resist pattern 31 formed on the recess 23 of the cliché 200 is stained on a roller 33 by rolling the roller 33 on the cliché 200 as shown in Figure 2b. The resist 31 stained on the roller 33 is same as the printing pattern formed on the cliché 200.

In addition, as shown in Figure 2c, the roller 33 on which the resist 31 of the pattern is stained is disposed on a substrate 30 to transfer the resist pattern 31 onto the substrate 30.

In case of forming a resist pattern by using the above-described printing method, the process is simple and a waste of a material (resist) cost can be prevented. However, the size of the pattern can differ according to a layer to be formed, and also differ with respect to the same layer.

At this time, viscosity of resist is determined according to the size of the pattern, and in this respect, with the various sizes of patterns, two or more types of resist each with different viscosity characteristics cannot be printed, resist suitable for a pattern of a suitable size must be selected.

Accordingly, when resist suitable for a pattern of a relatively small size is used, in the process of filling resist in the cliché and flattening it with the doctor blade, the resist is more removed from the middle region than from an edge region, causing a problem that the thickness of the pattern is not uniform.

Figures 3a and 3b illustrate a normally printed resist pattern 35a and a defective

resist pattern 35. As shown, the normally printed pattern 35a has the uniform thickness, and in case of the defective pattern 35b, the thickness of the resist is thin at the central portion to make the pattern have the non-uniform thickness. Since the thickness of the resist used as the mask is not uniform, the defective pattern is generated.

[Technical gist of the present invention]

Therefore, to solve the above problem of the related art, an object of the present invention is to provide a method for fabricating a liquid crystal display (LCD) device capable of prevent defective printing of a large pattern by dividing the large pattern into a size of a pattern with the best print state when resist suitable fro a small pattern is used.

Other objects and characteristics of the present invention will be described in detail in the construction of and claims of the present invention.

[Construction of the present invention]

To achieve the above object, there is provided a method for fabricating a liquid crystal display (LCD) device comprising: applying resist on a cliché having recesses of a pattern with a certain size; filling the resist in a recess and removing the resist remained on other regions except the recess by flattening surface of the cliché using a doctor blade; transferring the resist filled in the cliché onto a roller; and transferring the resist stained on the roller onto a substrate.

In this case, as the means for transferring the resist pattern onto the substrate, the roller may not be used, and the cliché can directly contact with the substrate, to which pressure or heat can be applied to transfer the resist filled in the cliché can be moved onto the substrate.

In order to form the resist pattern with the uniform thickness, resist favorable for

the pattern with a specific size capable of forming an optimum print pattern is used, and if the optimum print pattern is greater than the pattern, it can be divided.

In fabricating the LCD through the printing method, recesses of various patterns of sizes are formed on the cliché, and in the step of flattening the surface of the cliché with the doctor blade after the recesses of the cliché are filled with the resist, the thickness of the pattern may not be uniform according to characteristics of viscosity of the resist. For example, as mentioned above regarding the related art, when resist suitable for a narrow region is used to proceed with printing, there is no problem with respect to a narrower region than the region, but in case of a wider region, the resist would be thin compared with other region of the central portion.

Accordingly, the pattern of the wide region is formed to be divided into print patterns to allow formation of a print pattern having the optimum print characteristics, namely, print patterns with the same thickness, thereby improving the print characteristics of the resist.

The method for fabricating the LCD in accordance with the present invention will now be described with reference to the accompanying drawings.

Figures 4a through 4e are processing views illustrating a fabrication method of a liquid crystal display (LCD) device according to the present invention, and show processes of forming resist pattern in a printing method.

First, as shown in Figure 4a, after preparing a substrate 101, a buffer layer 103 such as metal, organic layer or silicon is applied on the substrate 101, and after that, a plurality of recesses 105a ~ 105c are formed through a photolithography process to fabricate a cliché 100. The role of the buffer layer 130 will be described in the following process.

The recesses 105a~105c are used to form a resist pattern. In substantially

fabricating the LCD, patterns designed for the same layer have various sizes, and accordingly, the recesses 105a~105c also have the various sizes. In this respect, however, for the sake of explanation, the first recess 105a allowing formation of an optimum print pattern, the second recess 105b having a line width d2 smaller than a line width d1 of the first recess 105a, and the third recess 105c having a line width d3 larger than the line width d1.

The first recess 105a forms a resist pattern with the uniform thickness. The third recess 105c is formed such that at least two or more first recesses 105a having the line width d1 are separated with a certain distance (w) therebetween, and forms a resist pattern with the uniform thickness without making the central portion thin. The distance (w) is determined according to viscosity and surface energy of used resist. Namely, if resist with high viscosity and surface energy is used, the distance (w) must be reduced so that interference can be made between adjacent resist patterns. Meanwhile, if resist with low viscosity and surface energy is used, the distance (w) must be increased.

When the cliché 100 is fabricated as above, as shown in Figure 4b, the resist is applied on the cliché 100, the resist 131 is filled in the recess 105 and the resist remained on other area is removed by flattening the cliché 100 using the doctor blade 132. At this time, viscosity of the resist is selected to make the resist pattern, which is formed by the first recess, namely, having the optimum uniform thickness.

When the filling of the resist 131 in the recess 105 of the cliché is completed as above, the resist 131 filled in the cliché 100 is separated and attached onto a roller 133. At that time, a blanket 134 is applied on a surface of the roller 133 in order to improve adhesiveness with the resist.

The buffer layer 103 makes the resist 131 separate easily from the cliché 100 to be attached to the roller 133, and protects the substrate from the impact of the roller. That

is, the adhesiveness of the resist with the substrate is weaker than that with the buffer layer, and therefore, the resist can be separated easily from the buffer layer. The recess may be formed by etching the substrate without forming the buffer layer on the substrate, however, cracks may be generated on lower part of the substrate due to the impact of the roller. Therefore, the buffer layer absorbs the impact of the roller to protect the substrate.

Also, the resist can be separated easily from the cliché using changes of adhesion property according to the temperatures. That is, in case that the resist having a characteristic that the adhesion property is improved as the temperature is increased is used, the resist can be separated from the cliché easily when the temperature of the printing roll is set to be higher than that of the cliché by building heaters in the cliché and the printing roll. In addition, in case that the resist having opposite characteristic from above, the resist can be separated from the cliché easily by setting the temperature of the printing roll to be lower than that of the cliché.

After attaching the resist filled in the cliché onto the roller, as shown in Figure 4d, the resist patterns 131 on the roller 133 are moved onto a stage 140, and then, the resist patterns 131 are transferred onto the substrate 130 which is disposed on the stage 140.

At that time, the resist pattern can be separated easily from the roller by controlling the temperature of substrate using a heater installed in the stage, and thereby, the pattern can be attached easily onto the substrate.

The heaters (not shown) installed on the cliché, the printing roll and on the stage should be able to control the temperatures differently from each other, and should be able to maintain even temperatures throughout entire areas of the cliché, the printing roll and the stage.

Figure 4e shows the resist pattern formed on the substrate 130 through the above processes. As shown therein, all the first to third patterns have the uniform thickness

regardless of their size.

A first pattern 106a is formed by resist filled in the first recess 105b, and the second and third patterns 106b and 106c are formed by resist filled in the first and second recesses 105b and 105c.

Figures 5a through 5c show another embodiment of the present invention, that is, a printing method by pressure that the pattern formed on the cliché is directly printed on the substrate without using the roller.

First, as shown in Figure 5a, resist 231 is filled on a cliché 200 in order to fill the resist in the cliché 200, and then, the cliché 200 on which the resist 231 is applied is flattened by a doctor blade 232 to remain the resist 231 on the recesses 205a and 205b and to remove the resist on other area.

In addition, as shown in Figure 5b, a substrate 230 which will be patterned is attached on the cliché 200, and then, heat or pressure is compressed.

Thereafter, as shown in Figure 5c, the substrate 230 is separated from the cliché 200 to form the resist patterns 206a~206c.

As mentioned above, in case of using the resist suitable for the small pattern, the large pattern is divided into a size of the small pattern with the best print state, so that a print pattern with the uniform thickness can be obtained for the large pattern.

[Effect of the invention]

As so far described, according to the fabrication method of the LCD device of the present invention, in using the printing method for formation of a resist pattern, when the light width of the cliche pattern is large, the pattern with the large line width is divided into small line widths to form uniform resist pattern. Accordingly, an etching deficiency caused by non-uniformity of the thickness of the resist can be prevented, and accordingly,

the production efficiency can be more enhanced.

What is claimed is:

1. A method for fabricating a liquid crystal display (LCD) device comprising:

preparing a cliché;

filling resist with a certain thickness in the cliché;

transferring the resist pattern filled in the cliché onto a roller; and

transferring the resist pattern with the uniform thickness put on the roller onto a substrate.

2. The method of claim 1, wherein the step of preparing the cliché comprises:

coating an organic material or a metal material on the substrate and forming a buffer layer thereon;

patterning the buffer layer to form recesses with various line width, respectively,

wherein when a line width of a recess allowing formation of an optimum resist pattern is W1 and a line width larger than the line width W1 is W3, the line width W3 is formed such that two or more line widths W1 are separated with a certain distance therebetween.

3. The method of claim 1, wherein the step of filling the resist having the uniform thickness in the cliché comprises:

applying the resist on the cliché; and

flattening the cliché with a doctor blade.

4. A method for fabricating a liquid crystal display device comprising:

coating an organic material or a metal material on a substrate and forming a buffer layer thereon;

patterning the buffer layer, preparing a cliché by forming recesses thereon;

applying resist on the cliché;

flattening the surface of the cliché with a doctor blade to fill the resist with a uniform thickness in the recesses, and removing resist remaining on the other region;

transferring the resist filled in the cliché onto a roller; and

transferring the resist pattern with the uniform thickness put on the roller onto the substrate,

wherein when a line width of a recess allowing formation of an optimum resist pattern is d1 and a line width larger than the line width d1 is d3, the line width d3 is formed such that two or more line widths W1 are separated with a certain distance therebetween.

5. A method for fabricating a liquid crystal display device comprising:

coating an organic material or a metal material on a substrate and forming a buffer layer thereon;

patterning the buffer layer, preparing a cliché by forming recesses thereon;

applying resist on the cliché;

flattening the surface of the cliché with a doctor blade to fill the resist with a uniform thickness in the recesses, and removing resist remaining on the other region; and

attaching the substrate on the cliché and transferring the resist pattern onto the substrate by applying heat or pressure thereto,

wherein when a line width of a recess allowing formation of an optimum resist

pattern is W1 and a line width larger than the line width W1 is W3, the line width W3 is formed such that two or more line widths W1 are separated with a certain distance therebetween.